National Transportation Safety Board

Flight Crew Response and Company Management of G650 Flight Test Program

Human Performance presentation

Flight Crew Response to Stall and Roll

- PIC's column push after first stick shaker activation was appropriate
- Pitch was reduced below PLI, and stick shaker activation ceased
- Airplane remained in a stall that overpowered lateral controls
- PIC was likely confused by airplane's response

Flight Crew Response to Stall and Roll

- PIC's column pull after second stick shaker activation was inappropriate
- Airplane was departing runway
- Conflicting cues, stress, and time pressure likely influenced PIC's response
- Recovery after second stick shaker activation was highly unlikely

G650 Program Management

- Technical planning and oversight
- Program scheduling
- Safety risk management

G650 Program Management: Technical Planning and Oversight

- Company manual separated duties of test planning and conduct from analysis and reporting
- Duty separation intended to facilitate timely and accurate task completion
- Duties were combined during G650 field performance testing
- FTE1 did not finalize analysis of key data in time to facilitate refinement of takeoff speeds

G650 Program Management: Technical Planning and Oversight

- Inadequate control gates
- Inadequate validation processes
  - Independent reviews of speed calculations
  - Physics-based dynamic analysis/simulation

G650 Program Management: Technical Planning and Oversight

- Inadequate development and implementation of on-site team member roles
- During accident flight, FTE2's responsibilities were unclear
- No engineer was assigned responsibility to monitor safety-related parameters compared with briefed limits

G650 Program Management: Program Schedule

- Ambitious schedule
- Frequent delays
- Unachievable deadlines
- Schedule pressure can lead to decision biases, shortcuts, and errors

G650 Program Management: Program Schedule

- Organizational processes can counterbalance schedule pressure
- Gulfstream lacked adequate technical oversight and safety management
- Schedule pressure likely played role in several key errors

G650 Program Management: Program Schedule

Schedule pressure likely influenced

- Decision to experiment with pilot technique rather than thoroughly analyze V_2 overshoots
- Decision to change target pitch without analyzing effect on takeoff speeds
- Decision to create pitch limit without adequately defining limit or including it on test cards
- Acceptance of oversimplified and inaccurate explanations for previous incidents

G650 Program Management: Safety Management

- Gulfstream had an FAA-accepted flight test risk assessment program
- No formal identification of stall-related events as potential hazard during continued takeoff testing
- Gulfstream's program lacking in area of safety assurance
- Previous stall-related events not adequately investigated

G650 Program Management: Safety Management

- FAA flight test safety guidance presented in terms specific to FAA's organizational structure
- FAA and International Civil Aviation Organization guidance not tailored to unique aspects of flight test (nonroutine, high-risk operations)

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